



# PROJECT PROGRESS REPORT

**PREPARED FOR THE ALASKA ENERGY AUTHORITY  
BY THE ALASKA CENTER FOR ENERGY AND POWER**

**PROJECT TITLE:** Emerging Energy Technology Fund – Data Collection

**COVERING PERIOD:** 2nd Quarter 2013

**DATE OF REPORT:** September 1, 2013

**GRANT RECIPIENT:** Alaska Center for Energy and Power  
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### Project #001 – Alaska Applied Sciences, Ammonia Synthesis

No work has been completed for this project during this quarter. ACEP is monitoring project pre-grant activities and communicating with AEA as to the status of the grant. If pre-grant activities are successfully completed and AEA approves further project activities, ACEP will be coordinating with AASI per the data collection plan on preliminary instrumentation review, specification, purchase, and installation for preliminary device demonstration.

### Project #003 – Alaska Division of Forestry, Biomass Reforestation

During this quarter, ACEP coordinated with the project team to install data loggers to record ground temperature of the planting sites. ACEP research engineers specified 5 HOBO field data loggers to be installed by the project team during their field planting activities: 1 logger each at the Cummings Road and Pogo Locations in Delta and 3 loggers at Mat-Su locations; 2 in the Willard Cash Rd/ Fish Hook Rd. logging area and 1 in the Sunset timber sale area. ACEP procured and programmed the data loggers, provided installation supplies, and conducted instrument orientation with the project team.

During an initial site visit to the Cummings Road site on 7/19, ACEP discovered that the logging equipment was inadequately covered, and the logger was wet.





ACEP performed a follow-up site visit to verify that logger was still functioning, and data was stored and being recorded. Once verified, ACEP re-installed logger with more durable weather protection.

Per this finding, ACEP conducted a site visit on 8/19 to the data logging site for the second Delta Junction location, at mile 18 along the Pogo Mine road. Upon arrival, Hobo was no longer sitting on post above the ground and was not covered. Data logger had been knocked over and was lying on the ground beside the stake (see first image). One thermocouple (thermocouple number 4) had been unplugged. ACEP ensured that the data logger was still functioning and reinstalled the data logger on the stake and fastened a more durable container over the top of it to protect it from weather (see second image).





ACEP discussed the condition of the loggers with the project team, in particular the need for proper staking and weather protection. The project team indicated they were originally concerned about logger vandalism, and had tried to install the loggers discretely (hence plastic cups and low staking). After discussion, the project team indicated they have re-installed the Mat-Su loggers appropriately.

Planned activities next quarter include verification of proper installation of Mat-Su loggers, and collection of summer data from loggers for review. It is anticipated that loggers will remain in place during the winter, providing base-line temperature information or renewed field activities next summer. In addition, ACEP will be collecting field notes from project team, including photos, of summer activities.

#### Project #006 – Arctic Sun, Arctic Thermal Shutters and Doors

Activities this quarter have focused on monitoring initial product development at Arctic Sun and design and specification of instrumentation and controls for the thermal testing chamber.

ACEP conducted a preliminary site visit on 6/3 to take a look at the status of the project shutter and door systems. Prototype of the sliding shutter was ready for testing. Prototype of the blown-in shutter was behind due to funds and material delays. Blown-in shutter system also had some unresolved issues including finding anti-static materials and automatic shut-offs. A follow-up site visit was conducted on 8/27. The project team had finalized a material for the blown-in shutter system and had resolved automatic shut-offs. Testing of the sliding shutter prototype had been completed and a final design was tentatively finalized. In addition, constructions had begun on the testing chamber. The project team, per ACEP collaboration, had identified a suitable thermostat for the chamber.

ACEP anticipates working closely with Arctic Sun during the next quarter on instrumenting and programming the controls for the testing chamber. It is anticipated that product testing will commence at the end of next quarter.

#### Project #009 – Genesis, Ultra-Efficient Generators and Diesel-Electric Propulsion

On June 20-21 20013, ACEP staff engineers Tom Johnson and Annie Goering conducted a site visit to Genesis machining in Kodiak, Alaska to evaluate progress and assist with instrumentations needs.

Initial impressions of Genesis are positive--they are a small “garage shop” and seem quite capable. Most work is done in-house with a full machine shop. They lack the overhead of a conventional company and seem to use that to their advantage and are quite nimble.





Figure 1



Figure 2



Figure 3

During the course of this visit, calibrations were checked and preliminary inverter efficiency numbers were generated. Initial results indicate an inverter efficiency of  $>90\%$  although, for reasons that will be discussed below, this number cannot yet be reported with confidence. The UMIC outputs a somewhat unique current and voltage waveform. The waveform is monitored and analyzed using built-in LabVIEW routines to determine power. However, given the unique nature of the signal, there is some uncertainty as to the efficacy of the built-in routines. ACEP is investigating an alternative method of determining power using a dedicated instrument.

Motor efficiency is to be determined. Ideally a torque meter would be installed between the PDM and vehicle transmission. Unfortunately, space constraints make this installation unreasonable. As an alternative, Genesis has a method of testing efficiency that does not need a meter but this method does require proofing. To that end, Genesis proposes to bench test a PMD outfitted with a torque meter to validate their method of determining efficiency. ACEP concurs and will supply an appropriate meter to assist with the test.

Data is not yet being saved. Genesis has the instrumentation in place, and it is now simply a matter of saving the data to a file. Genesis indicated that this change will happen in the near future.

Genesis's data acquisition and control system is quite sophisticated and allows for quick modification of the UMIC parameters. The system is LabVIEW based and some programming assistance was provided. It is anticipated that they may need more help in the future.



Additionally, the bus phase of the project was discussed. Genesis is moving ahead and beginning the preliminary planning for the conversion of the school bus to diesel-electric. Several strategies for measuring fuel flow are under investigation.

Additional site visits are expected as Genesis progresses and move on to their next phase. Genesis constructed an initial prototype vehicle (figure 1) that incorporates their Power Dense Motor (PDM) shown in figure 2 as well as their Universal Modular Inverter controller (UMIC) shown in figure 3. This vehicle is battery powered and, although not completely trouble free, functions quite well. ACEP is currently in the process of procuring the torque meter for the project. In addition, ACEP believes the project will need a dedicated instrument for measuring three-phase power, and anticipates procuring this instrument next quarter. ACEP is currently planning a follow-up site visit for next quarter to review supplemental instrumentation installation and project progress. In addition, ACEP is working with the project team to develop a fuel flow measuring instrument.

#### Project #026 – Cold Climate Housing Research Center, Ground-Source Heat Pump

Activities this quarter have focused on monitoring the installation of the ground loop, instrumentation, and heat pump at the CCHRC facility. ACEP conducted a preliminary site visit on 6/12 to review ground loop installation and meet the project team. The following photos document the coiled ground loop being placed:







ACEP conducted a follow-up site visit on 8/26. CCHRC was installing the thermistor strings for ground loop temperature monitoring. The heat pump itself had not yet been installed as the vendor was experiencing delays in receiving parts. CCHRC had installed several different coatings to the ground loop surface (colored sand, gravel, etc.) and was planning on fencing in the loop to protect it from thermal disturbance such as snow piling. System plumbing and instrumentation internal to the building had been completed, awaiting the installation of the heat pump and buffering tank.

It is anticipated that activities next quarter will include commissioning the instrumentation of the system with CCHRC, and commencing live data collection from the system.

#### Project #028 – University of Alaska Fairbanks, Organic Rankine Cycle

ACEP conducted a preliminary site visit to the Organic Rankine Cycle project at the University of Alaska, Fairbanks on 6/19. Construction of the testing apparatus was well under way. A good portion of the assembly had been completed. The image below depicts the somewhat complete testing apparatus. The apparatus is compiled of two glass chambers connected with piping to promote passage of gasses between the chambers. The secondary chamber will be the main testing component. The surface of the secondary chamber will have

hydrophobic coating. Insulation will be installed surrounding the chambers to ensure condensation does not take place.



Chilled water is circulated through the metal box on the right side to cool the metal surface on the right side of the secondary chamber. This promotes condensation on the metal surface.

An instrumentation plan was discussed and thermocouple measurement locations were indicated. Three thermocouples will measure the temperature gradient through the length of the aluminum core located between the secondary chamber and the chilled water. A second site visit will provide more insight into the completed testing apparatus along with the complete instrumentation plan.

It is anticipated that the project will commence testing next quarter. ACEP will be conducting follow-up site visits to review final instrumentation and data collection.

#### Project #029 – University of Alaska Fairbanks, Exhaust Thimble

The project team has manufactured their first thimble and begun construction of the test bed. ACEP reviewed the instrumentation plans and preliminary instrumentation of the test bed. In addition, ACEP worked with the project team to address some instrumentation issues and provided isolation amplifiers. The project team is finalizing calibration of the test bed. It is anticipated that the project team will commence testing next quarter, at which time ACEP will review final instrumentation and data collection.

#### Project #035 – Altaeros, Airborne Wind Turbine

Activities this quarter have focused on monitoring project progress and grant milestone completion. ACEP met with the project team during their Alaska visit in July, and discussed the data collection plan integrated in to the grant agreement. It is anticipated that only project monitoring activities will be continued next quarter.

#### Project #037 – Oceana, Hydrokinetics

No work has been completed for this project during this quarter. ACEP is monitoring project pre-grant activities and communicating with AEA as to the status of the grant. In addition, the ACEP data collection team is monitoring discussions between the project and the Alaska Hydrokinetic Energy Research Center with regards to barge design and construction, and Nenana test site use. Depending on project progress, ACEP may conduct a site visit to initial device testing in Virginia next quarter.

#### Project #043 – ORPC Alaska, Hydrokinetics

Activities this quarter have focused on monitoring project progress and grant milestone completion. ACEP has had some discussions with the project team concerning the planned work at Nikiski and TGU testing in Maine. In addition, ACEP has been in continued discussions with the project team concerning demonstration of power electronics at the ACEP Power Systems Integration Laboratory.

ORPC has indicated that Nikiski testing will commence during the next quarter (Fall 2013). ACEP intends on conducting a site visit during testing, in particular to review deployment and retrieval methodology and pontoon deployment instrumentation. In addition, ACEP will continue to monitor the schedule of TGU testing in Maine.

#### Project #045 – Hatch, Flywheel

ACEP is monitoring project pre-grant activities and communicating with AEA as to the status of the grant. ACEP met with the project team during a conference held in Toronto to discuss grant and project status. The ACEP data collection team is also monitoring discussions between the project and the ACEP Power Systems Integration laboratory with regards to testing schedule and protocols.

#### Project #049 – Intelligent Energy Systems, Self-Regulated Grid, Project #051 – Intelligent Energy Systems, Wind-Diesel-Battery Hybrid System

ACEP has been jointly monitoring the two IES projects as they are still in the design and procurement phase. ACEP had initially planned a site visit to the two project locations this quarter, but based on feedback by the project team, rescheduled for a joint site visit during Q4 2013. This site visit will review the installed systems and instrumentation.

ACEP has also been monitoring ongoing discussions between the project team and the ACEP Power Systems Integration lab, specifically for the pre-demonstration of a Steffes unit (Project #049). It is anticipated that pre-demonstration will be conducted at another location on the UAF campus, although no final plans have been announced.

#### Project #058 – BRI, Hydrokinetics

Activities this quarter have focused on monitoring project progress and grant milestone completion. ACEP has been in communication with the project team regarding instrumentation and controls specification and plans. In addition ACEP has monitored planned testing activities in the Tennessee River, and anticipates a site visit next quarter to review these efforts (instrumentation and testing results).



Project #061 – Marsh Creek, Various Speed Diesel-Electric Generation

ACEP has been monitoring project activities, including holding preliminary discussions regarding instrumentation and testing. The project is currently behind schedule. ACEP anticipates renewing project data collection activities next quarter, including a site visit to review the test bed.